Nov. 17, 1953

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2,659,844

BURNER CONTROL SYSTEM

Filed Oct. 27, 1947

3 Sheets-Sheet 1

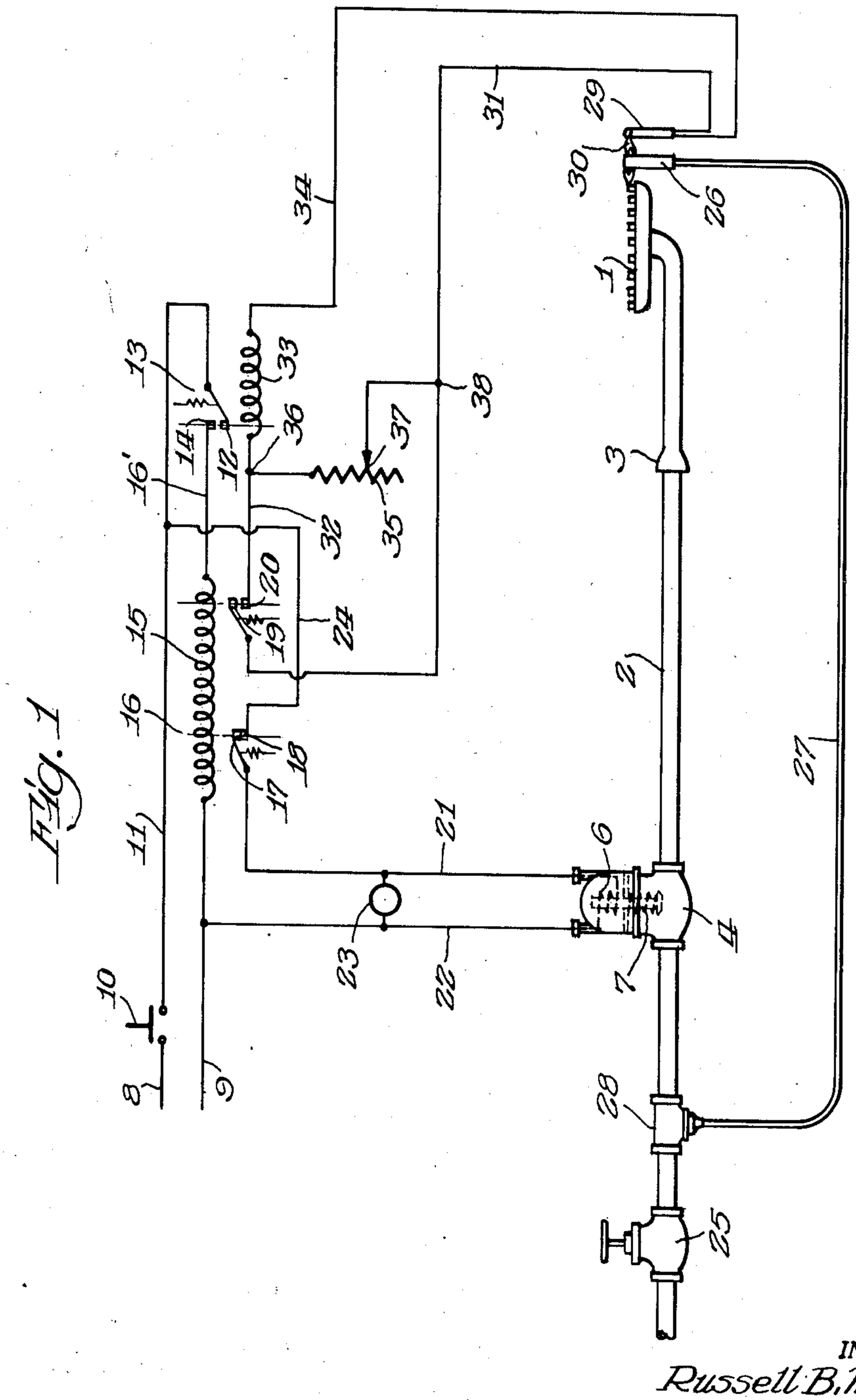

Fig. 1

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3 Sheets-Sheet 2

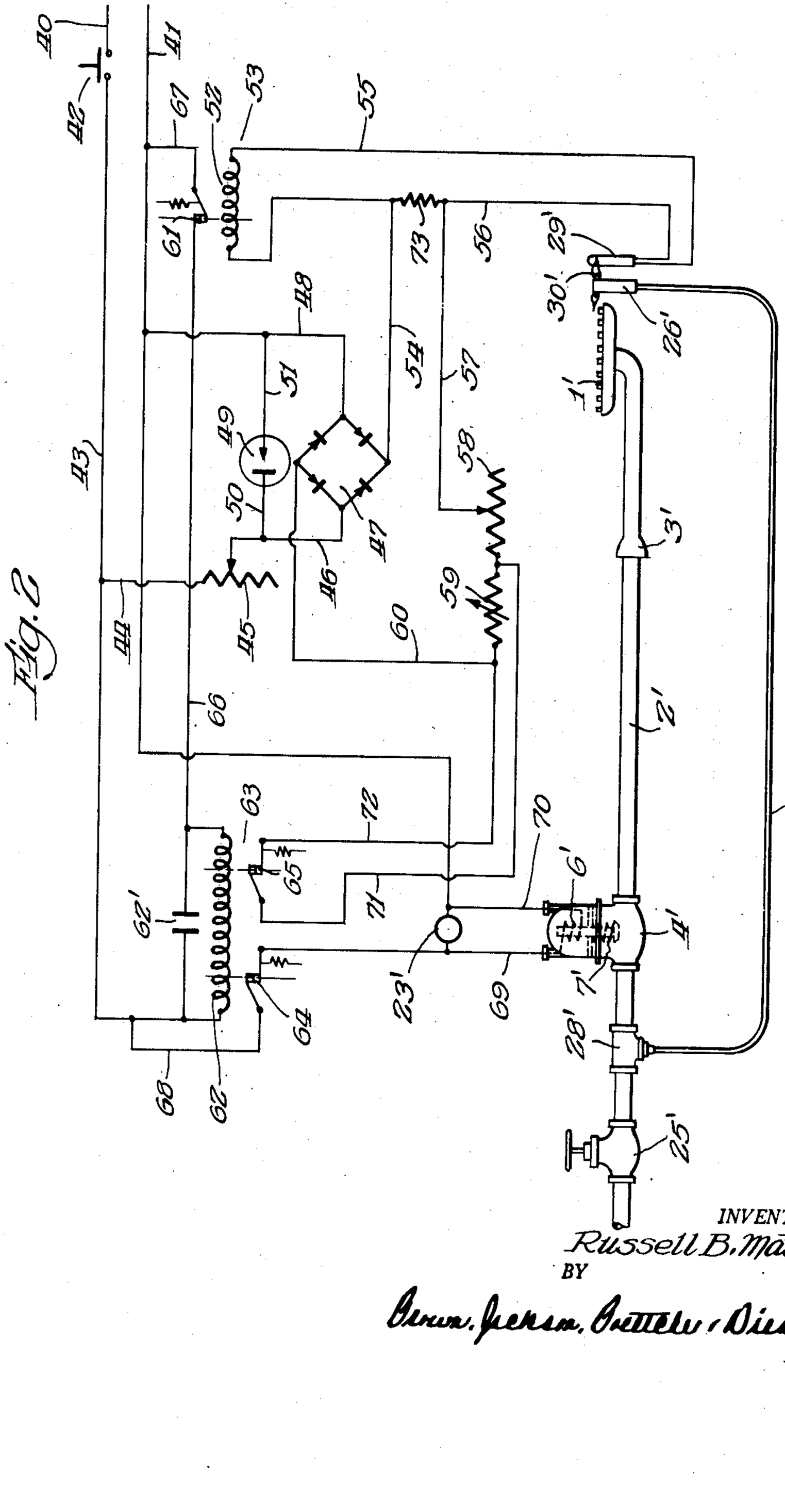

Fig. 2

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3 Sheets-Sheet 3

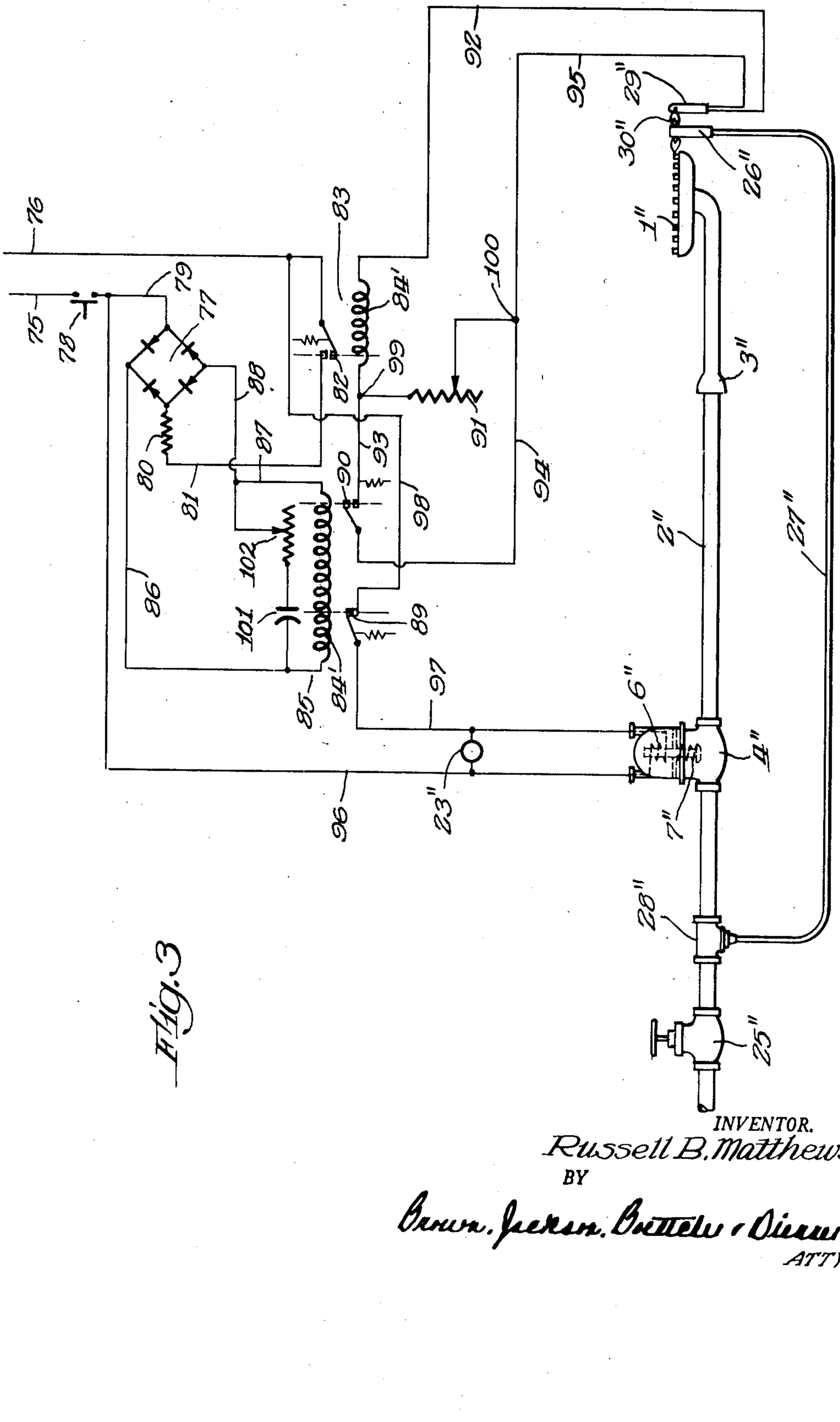

Fig. 3

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UNITED STATES PATENT OFFICE

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BURNER CONTROL SYSTEM

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8 Claims. (Cl. 317—132)

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This invention relates, in general, to burner control systems, and is particularly concerned with obtaining quick fuel shutoff of such systems when the pilot flame is extinguished.

While quick fuel shutoff systems of the character disclosed and claimed in the present application are particularly useful in industrial ignition systems, it is to be understood that the invention is not limited to such use but may be employed in domestic burner control systems and elsewhere as suitable or desired.

In the case of a gas burner, or a series of gas burners, the gas is usually mixed with air in a mixing chamber adjacent to each burner, and the combustible mixture of gas and air is conducted to the burner or burners where it is ignited by a pilot flame in lighting proximity to each burner. If there is delay in the fuel shutoff when the pilot flame is extinguished, a highly explosive gas-air mixture may escape unlighted from the burner, thus presenting the possibility of a serious and disastrous explosion, particularly where it is attempted promptly to relight the pilot burner.

One of the main objects of the present invention is to provide improved means which will operate automatically to provide quick fuel shutoff of the system when the pilot flame is extinguished.

Another object of the invention is to provide variable means for adjusting the time for fuel shutoff after the pilot flame is extinguished.

Another object of the invention is to provide variable means for adjusting the time for fuel turn-on after the pilot flame has been ignited, and, more particularly, an improved combination of variable means for adjusting both the time for fuel shutoff after the pilot flame is extinguished and the time for fuel turn-on after the pilot flame has been ignited.

Another object of the invention is to eliminate or reduce relay chatter by using D. C. current to energize the relays.

Another object of the invention is to provide a system in which greater stability is assured on short fuel shutoff time.

Another object of the invention is to provide burner control systems of the character described having various features of novelty and advantages, and which are particularly characterized by their simplicity in construction and installation, their economy in manufacture, and their effectiveness in use.

Further objects and advantages of the invention will appear from the following detailed description, taken in connection with the accompanying drawings which illustrate the manner of constructing and operating certain embodiments of the invention.

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In the drawings:

Figure 1 is a diagram showing, schematically, the parts and circuit connections of one form of system embodying the present invention;

Figure 2 is a diagram showing another form of system embodying the invention; and

Figure 3 is a diagram showing a further form of system embodying the invention.

Referring first to Figure 1, the burner shown at 1 is a main burner. The use of the invention with a series of burners is also contemplated. The burner 1, which, of course, is illustrative, may be the main burner for a room or space heater, or it may be the burner for a water heater or for a floor furnace, an oven burner, one or more top burners for a gas range, or any other burner or series of burners, and of any suitable construction.

A fuel supply pipe or conduit 2 leads to the burner 1 for the delivery of gaseous fuel thereto, for example, through a mixing chamber 3 to which air is admitted through adjustable air inlets (not shown), as well understood in the art. The flow of fuel through conduit 2 is controlled by a valve 4 of any suitable electroresponsive or electrically operated type. For purposes of illustration, the valve 4 may be a solenoid valve operated to open position by the flow of electric current through its coil 6, and to closed position by a spring 7.

Electric power is applied from a suitable source of current, such as, for example, the usual 110–120 volt alternating current line which is shown as comprising conductors 8 and 9. Conductor 8 is adapted to be connected by a push button switch 10 with conductor 11 which extends to and is connected in circuit with contact 12 of a relay 13. The other contact 14 of relay 13 is connected in circuit with one end of coil 15 of relay 16 by conductor 16'. Conductor 9 extends to and is connected in circuit with the opposite end of coil 15.

Relay 16 has a pair of normally closed contacts 17 and 18 and a second pair of normally open contacts 19 and 20 (relay 16 deenergized). Contact 17 is connected by a conductor 21 in circuit with one side of coil 6 of valve 4, and the other side of coil 6 is connected by a conductor 22 in circuit with the conductor 9. An alarm or other suitable signal device 23, audible or visible, is connected across conductors 21 and 22. The other contact 18, which cooperates with con-

tact 17, is connected by a conductor 24 in circuit with conductor 11.

Interposed in fuel supply pipe 2 anterior of valve 4 is a manual shutoff valve 25. A pilot burner 26, located in juxtaposition or in lighting proximity to burner 1, is supplied with fuel by a pilot supply pipe or conduit 27 connected to the fuel supply conduit 2, for example, at 28, between valves 25 and 4, or otherwise supplied with fuel.

A thermoelectric generator 29'—such as a thermocouple or thermopile—is located in juxtaposition to the pilot burner 26 so that its "hot" thermojunction, or thermojunctions, will be heated by the pilot flame 30 as long as the pilot burner is ignited. One side of the thermoelectric generator 29 is connected by a conductor 31 in circuit with relay contact 19. The other contact 20, which cooperates with contact 19, is connected by a conductor 32 in circuit with one end of coil 33 of relay 13. The other end of relay coil 33 is connected by a conductor 34 in circuit with the other side of thermoelectric generator 29. An adjustable resistor 35 is connected to the conductor 32 at 36, and the adjustable contact 37 of the resistor 35 is connected to conductor 31 at 38.

In operation, opening valve 25 admits gas to solenoid valve 4 and pilot burner 26. Line voltage applied to conductors 8 and 9 (push button switch 10 being closed) energizes relay coil 15 through conductor 8, push button switch 10, conductor 11, contacts 12, 14, conductor 16', relay coil 15 and conductor 9. Contacts 12, 14 are closed when relay coil 33 is deenergized, which occurs when pilot flame 30 is not burning and thermoelectric generator 29 is cold. When relay 16 is energized, contacts 17, 18 are opened, and contacts 19, 20 are closed, which shorts out the fuel shutoff time adjustment resistor 35.

When pilot burner 26 is ignited, the "hot" thermojunction or thermojunctions of thermoelectric generator 29 become hot and relay coil 33 is energized through a path consisting of conductor 31, contacts 19, 20, conductor 32, relay coil 33, and conductor 34. Contacts 12, 14 open, and relay coil 15 is deenergized. Deenergizing relay coil 15 closes contacts 17, 18 and opens contacts 19, 20. When contacts 17, 18 are closed, power is applied to solenoid valve 4 and alarm 23 through conductors 9 and 22, coil 6 of solenoid valve 4, conductor 21, contacts 17, 18, conductors 24 and 11, push button switch 10 and conductor 8. Energizing solenoid valve 4 opens this valve, and fuel is supplied to the main burner 1. When contacts 19, 20 are opened, resistor 35 is placed in the circuit of the thermoelectric generator. With adjustable resistor 35 in the circuit it is possible to regulate the drop-out time of relay 13 as desired. With resistor 35 shorted out of the circuit, relay 13 assumes its normal pull-in time which depends on current strength.

If the flame of the pilot burner 26 is extinguished, the "hot" thermojunction or thermojunctions of the thermoelectric generator 29 cool, and relay 13 deenergizes quickly because of the presence of the resistor 35 in the circuit of the thermoelectric generator at such time. When the relay 13 deenergizes, contacts 12, 14 close and relay 16 is again energized as previously stated. When relay 16 is energized, contacts 17, 18 are opened and contacts 19, 20 are closed, which shorts out the fuel shut-off time adjustment resistor 35.

When contacts 17, 18 are opened, power is removed from the solenoid valve 4 and from the alarm 23. Upon deenergization of solenoid valve 4 the valve operates to closed position and shuts off the gas supply to the main burner. The circuit is now ready for a new cycle of operation.

In the system shown in Figure 2, the main burner, mixing chamber, fuel supply pipe or conduit for supplying fuel to the main burner, manual shutoff valve, pilot burner and its connection with the fuel supply conduit and thermoelectric generator are similar to the showing in Figure 1 and are designated by primed reference characters corresponding with the reference characters used in Figure 1.

In Figure 2 electric power is supplied from a suitable source of current, such as, for example, the usual 110–120 volt alternating current line which is shown as comprising conductors 40 and 41.

Line voltage applied to conductors 40 and 41 supplies potential to a voltage and current regulated rectifier circuit through conductor 40, push button switch 42, conductors 43 and 44, dropping resistor 45, and conductor 46, rectifier 47, and conductors 48 and 41. Compensating resistor 45 regulates the current through the circuit; voltage regulating tube 49, which shunts rectifier 47 by conductors 50 and 51, regulates the voltage. When power is applied to the rectifier circuit, its D. C. output energizes coil 52 of relay 53 through a path comprising conductors 54 and 55, relay coil 52, thermoelectric generator 29', conductors 56 and 57, and fuel shutoff time adjustment resistor 58, fuel turn-on time adjustment resistor 59, and conductor 60.

With relay 53 energized, contacts 61 are open and coil 62 of relay 63 cannot be energized. With relay coil 62 deenergized, contacts 64 are open and contacts 65 are open, which places fuel turn-on adjustment resistor 59 in the circuit of the thermoelectric generator 29'. Capacitor 62', shown, for example, in the form of a fixed capacitor, shunts relay coil 62.

The polarity of the thermoelectric generator 29' is so arranged that when pilot burner 26' is ignited and the "hot" thermojunction or thermojunctions of the thermoelectric generator 29' are hot or heated, the voltage of the thermoelectric generator 29' supplied through conductors 56 and 55 opposes the voltage produced in resistor 73 by the rectifier. The voltage produced across resistor 73 by the rectifier can be adjusted by fuel turn-on time adjustment variable resistor 59. When the voltage applied by the thermoelectric generator becomes great enough, relay coil 52 is deenergized and relay contacts 61 close. When contacts 61 close, relay coil 62 is energized through conductor 40, push button switch 42, conductor 43, relay coil 62, conductor 66, contacts 61, and conductors 67 and 41.

When relay coil 62 is energized, contacts 64 and 65 close. When contacts 64 close, power is supplied to coil 6' of solenoid valve 4', and alarm or signal 23' through conductor 40, push button switch 42, conductors 43 and 68, contacts 64, conductor 69, coil 6' of solenoid valve 4', alarm 23', and conductors 70 and 41. Energizing coil 6' of solenoid valve 4' opens the solenoid valve and fuel is supplied to main burner 1'. When contacts 65 close, resistor 59 is shorted out of circuit through conductor 71, contacts 65 and conductor 72.

When resistor 59 is shorted out of circuit, the current through relay coil 52 from the rectifier

circuit increases for quick fuel turn-on. When resistor **59** is in the circuit the current through relay coil **52** is decreased, and only a small amount of current from thermoelectric generator **29'** is necessary to open relay contacts **61**. This provides for quick fuel turn-on time.

When the pilot flame of pilot burner **26'** is extinguished, the "hot" thermojunction or thermojunctions of thermoelectric generator **29'** cool, relay coil **52** is energized, contacts **61** open, and relay coil **62** is deenergized. When relay coil **62** is deenergized, contacts **64** and **65** open. When contacts **64** open, power is removed from coil **6'** of solenoid valve **4'**, and alarm or signal **23'** is deenergized. Solenoid valve **4'** closes when deenergized, and shuts off the supply of gas to the main burner **1'**. The opening of contacts **65** places resistor **59** in the circuit. The circuit is now ready for a new cycle of operation.

Like the system shown in Figure 1, the system shown in Figure 2 provides means for automatically turning on and shutting off the fuel supply to a burner or series of burners when the pilot flame is extinguished; also a variable means of adjusting the time for fuel shut-off after the pilot is extinguished. The system shown in Figure 2 also provides a variable means of adjusting the time for fuel turn-on after the pilot has been lighted. The relay and sliding contacts of Figure 2 are operable at a higher voltage potential than possible with the system shown in Figure 1, although, of course, the systems may be varied in these respects.

In the system shown in Figure 3, the main burner, mixing chamber, fuel supply pipe or conduit for supplying fuel to the main burner, manual shut-off valve, pilot burner, and its connection with the fuel supply conduit and thermoelectric generator are similar to those shown in Figure 1 and are designated by double primed reference characters corresponding with the reference characters used in Figure 1.

In Figure 3, electric power is supplied from a suitable source of current, such as, for example, the usual 110–120 volt alternating current line which is shown as comprising conductors **75** and **76**.

In operation of the system shown in Figure 3, opening of valve **25''** admits gas to solenoid valve **4''** and pilot burner **26''**. Line voltage applied to conductors **75** and **76** supplies power to rectifier **77** through conductor **75**, push button switch **78**, conductor **79**, rectifier **77**, dropping resistor **80**, conductor **81**, contacts **82** of relay **83**, and conductor **76**. Contacts **82** are closed when coil **84** of relay **83** is deenergized, which occurs when pilot burner **26''** is extinguished and the "hot" thermojunction or thermojunctions of thermoelectric generator **29''** are cold. When rectifier **77** is supplied with potential, coil **84'** of relay **85** becomes energized through conductor **86**, relay coil **84'**, and conductors **87** and **88**. When relay coil **84** is energized, contacts **89** are opened, and contacts **90** are closed, which shorts the fuel shut-off time drop-out resistor **91** out of circuit.

When pilot burner **26''** is ignited, the "hot" thermojunction or thermojunctions of thermoelectric generator **29''** become hot or are heated and relay coil **84** is energized through a path comprising conductor **92**, relay coil **84**, conductor **93**, contacts **90** and conductors **94** and **95**. When relay **83** is energized, contacts **82** open and relay coil **84'** is deenergized. Deenergizing relay coil **84'** closes contacts **89** and opens contacts **90**. When contacts **89** are closed power is applied

to coil **6''** of solenoid valve **4''**, and alarm **23''** through conductor **75**, push button switch **78**, conductor **96**, coil **6''** of valve **4''**, and alarm **23''**, conductor **97**, contacts **89**, and conductors **98** and **76**. Energizing solenoid valve **4''** opens this valve and gas or fuel is supplied to the main burner **1''**. When contacts **90** are opened, resistor **91**, connected to conductor **93** at **99**, is placed in the circuit. The movable contact of adjustable resistor **91** is connected to conductor **94** at **100**. Capacitor **101**, shown in the form of a fixed capacitor, and a variable resistor **102** shunt relay coil **84'**.

With adjustable resistor **91** in the circuit, it is possible to regulate the drop-out time of relay **83**. With resistor **91** shorted out of circuit, relay **83** assumes its normal pull-in time. If the flame of pilot burner **26''** is extinguished, the "hot" thermojunction or thermojunctions of thermoelectric generator **29''** cool, and relay **83** is deenergized quickly because of resistor **91**. When relay **83** is deenergized, contacts **82** close and relay coil **84'** is again energized, as stated previously. When relay coil **84** is energized, contacts **89** are opened and contacts **90** are closed, which shorts out quick drop-out resistor **91**. When contacts **89** are opened, power is removed from the solenoid valve **4''**. Deenergizing solenoid valve **4''** causes this valve to close and shut off the supply of gas to the main burner **1''**, and the alarm **23''** is altered. The circuit is now ready for a new cycle of operation.

Like the systems shown in Figures 1 and 2, the system shown in Figure 3 provides means for automatically turning on and shutting off the fuel supply to a burner or series of burners, and for simultaneously operating an alarm or signal system when the pilot flame is extinguished; also a variable means of adjusting the time for fuel shut-off after the pilot flame is extinguished. With the system shown in Figure 3, relay chatter is eliminated by using D. C. current to energize the relays, and a greater stability is assured on short fuel shutoff time.

The embodiments of the invention shown in the drawings are for illustrative purposes only, and it is to be expressly understood that said drawings and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. Thermoelectric control means comprising, in combination, an electroresponsive control device having operating and safety positions, a first circuit for energization by a source of electric power, a thermoelectric generator adapted when heated to establish a thermoelectric current, first means under control of thermoelectric current established by said thermoelectric generator and operating conjointly with second means under control of said first circuit for causing application of electric power from said first circuit to said electroresponsive control device to operate same to its operating position when said thermoelectric generator is heated, resistor means, and third means under control of said first circuit for completing a circuit including said thermoelectric generator, said resistor means, and said first means upon application of electric power from said first circuit to said electroresponsive control device, said resistor means acting to increase the rapidity of action of said electroresponsive control device to a safety position upon

cessation of heating of said thermoelectric generator.

2. Thermoelectric control means according to claim 1 wherein the resistor means is adjustable to adjust the interval of time between cessation of heating of the thermoelectric generator and operation of the electroresponsive control device to safety position.

3. Thermoelectric control means according to claim 1 wherein the resistor means is adjustable and by its adjustment acts to adjust the interval of time between commencement of heating of the thermoelectric generator and operation of the electroresponsive control device to operating position.

4. Thermoelectric control means according to claim 1 wherein the resistor means is adjustable and by its adjustment acts to adjust both the interval of time between cessation of heating of the thermoelectric generator and operation of the electroresponsive control device to safety position and the interval of time between commencement of heating of the thermoelectric generator and operation of the electroresponsive control device to operating position.

5. Thermoelectric control means according to claim 1 wherein the resistor means comprises a first resistor for reducing the interval of time between cessation of heating of the thermoelectric generator and operation of the electroresponsive control device to safety position, and a second turn-on time adjustment resistor in series circuit relation with said first resistor.

6. Thermoelectric control means according to claim 1 wherein the resistor means comprises a first resistor for reducing the interval of time between cessation of heating of the thermoelectric generator and operation of the electroresponsive control device to safety position, a second turn-on time adjustment resistor in series circuit relation with said first resistor, and means for completing a circuit including the thermoelectric generator with said second turn-on time adjustment resistor shorted out of said circuit when electric power is applied to the electroresponsive control device.

7. Thermoelectric control means according to claim 1 wherein the second means comprises a coil in the first circuit and a pair of contacts under control of said coil and wherein there is a second pair of contacts under control of said coil and operable to include the resistor means in circuit with the thermoelectric generator and the first means and to complete the circuit through the thermoelectric generator and the first means around the resistor means.

8. Thermoelectric control means according to claim 1 wherein electric current is supplied to the first means from the first circuit and the thermoelectric current established by heating of the thermoelectric generator acts in opposition thereto.

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